Phase Change Permeation Technology for Environmental Control & Life Support Systems

Completed Technology Project (2012 - 2013)

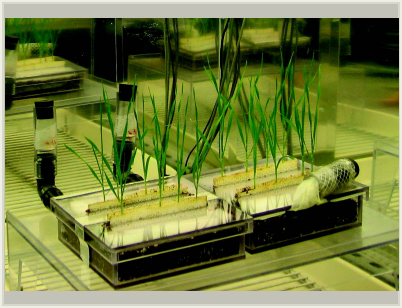
Project Introduction

NASA is evaluating Dutyion™, a phase change permeation membrane technology developed by Design Technology and Irrigation (DTI), for use in future advanced life support systems. The phase change membranes could be used to passively and selectively mobilize water in microgravity to recover more water from urine and brine for environmental control and life support systems (ECLSS). A system using such technology might also be able to deliver water to plants in low gravity.

This project will explore a recent advancement in Phase Change Permeation™ technology to enable improved (1) water recovery from urine/brine for Environmental Control and Life Support Systems, and (2) water delivery to plants for potential use in microgravity. The innovation is the use of a phase change permeation membrane to passively and selectively mobilize water in microgravity. Test objectives for water purification will determine the effects of temperature and waste water chemical composition on the water flux rate across the membrane and the chemical and microbiological water quality of permeate and effluent streams. Test objectives for water delivery to plants will determine the soil wetting characteristics of the Dutyion™ membrane material in normal gravity in preparation for future proposed flight testing.

Anticipated Benefits

This membrane may enable recovery of water from wastewater or brines generated by physical chemical water recovery systems, or enable polishing of water from biological water recovery systems increasing ECLSS efficiency. The passive nature of the "pervaporation" process would allow operation in a u-gravity environment. For root hydration in reduced gravity environments, Phase Change Permeation™ technology could reduce plant stress by allowing passive transfer of water vapor to the root zone of the plants. Water stress is a limiting factor for many terrestrial agricultural systems, and must also be controlled in plant growth systems deployed in microgravity.



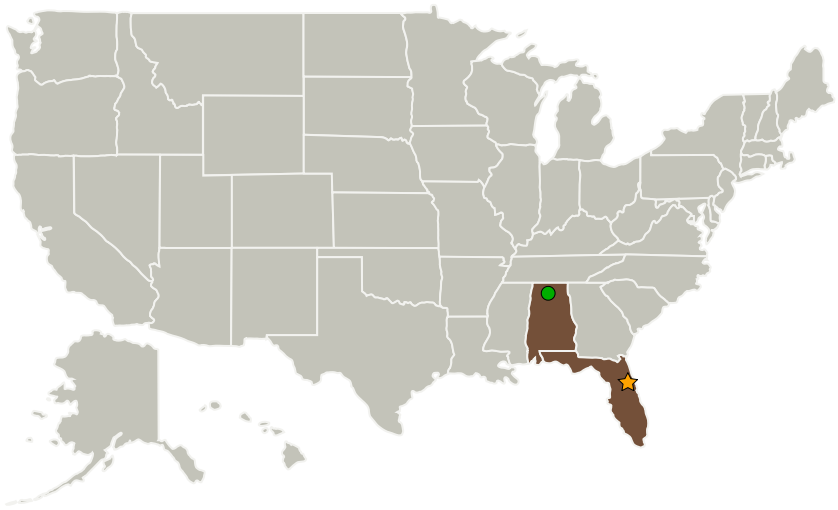
Wheat growth with DTI materials used to irrigate commercial potting soil.

Table of Contents

Phase Change Permeation Technology for Environmental Control & Life Support Systems

Completed Technology Project (2012 - 2013)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Design Technology & Irrigation, Ltd.(DTI)	Supporting Organization	Industry	
●Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
QinetiQ North America(QNA)	Supporting Organization	Industry	

Primary U.S. Work Locations	
Alabama	Florida

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Independent Research & Development: KSC IRAD

Project Management

Program Manager:

Barbara L Brown

Project Manager:

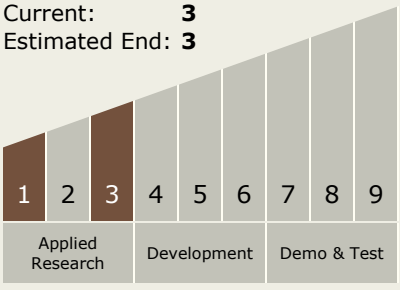
Raymond M Wheeler

Principal Investigator:

Howard G Levine

Technology Maturity (TRL)

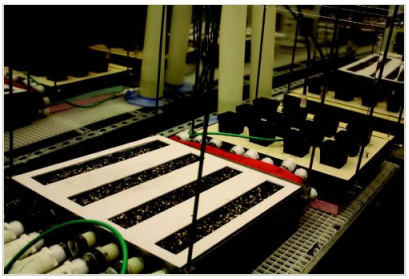
Start: **1**
Current: **3**
Estimated End: **3**



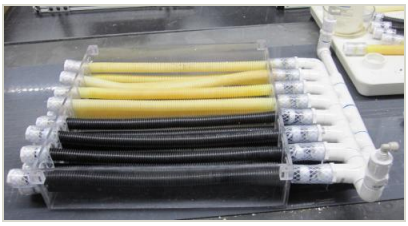
Phase Change Permeation Technology for Environmental Control & Life Support Systems

Completed Technology Project (2012 - 2013)

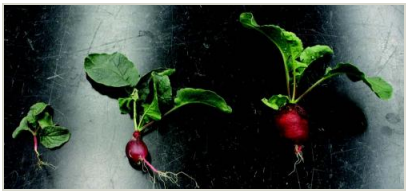
Images



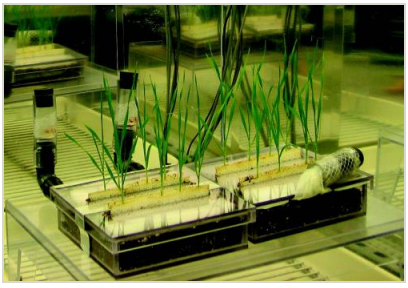
Large Root Module using DTI Tubes and Membranes
A large root module with increased surface area for pervaporation was constructed using Dutyion tubing. Plant growth in the root module was compared against growth in conventional, passively irrigated pots.
(https://techport.nasa.gov/image/2588)



Phase Change Permeation Technology
Phase Change Permeation Technology for Environmental Control & Life Support Systems
(https://techport.nasa.gov/image/2264)



Radishes Grown in Root Modules
Radishes grown in root modules watered with salt and distilled water were smaller and had less moisture content than those grown in conventional pots. Radish growth was severely inhibited when seawater was used in the Dutyion tubing.
(https://techport.nasa.gov/image/2589)



Two Root Modules Using DTI Tubes and Membranes
Wheat growth with DTI materials used to irrigate commercial potting soil.
(https://techport.nasa.gov/image/2587)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.2 Water Recovery and Management